Synchronizing Remote Atomic Clocks via Neutrino-Based Latency Measurement

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Introduction

It is extremely difficult to synchronize two atomic clocks with relevant accuracies sc. the regime of femtosecond precision. However, time-dilation-based cybersecurity systems predicated upon the publication of 25 September 2023 would, at minimum, require that disparate atomic clocks integrated into computer systems be able to communicate timecodes in such a manner that the precise latency in the transmission of that timecode could be known to both parties i.e. the authenticity of a communication is established by knowledge of how time should pass in a given location which takes into account local gravitational conditions, which vary with geography. It would be necessary for such systems to remain in a fixed location for that application, however, either an entanglement-based approach or a neutrino-based approach may be used to communicate information concerning the drift in remote atomic clocks.

Abstract

Although an entanglement-based approach to communicating this type of information would be ideal given the zero latency, there may be some advantage to being able to perform the same function; of querying a remote system with regard to the length of time it takes a signal to reach the destination, using neutrinos. Neutrinos would allow information to be transmitted in such a way that the wave propagation (neutrinos do not truly move in waves, but in packets,) speed would not be affected by gravitational, magnetic or atmospheric conditions. Signals could penetrate the crust of the Earth so as to be able to travel in a linear fashion toward the destination. Neutrinos are also slightly faster, moving at C • 1.025.

Thus, authentication according to timecode as well as according to the latency of the signal as well as the unique method of receiving and transmitting the signal would form the basis of a powerful security regime. It would be difficult for an adversary to know the precise gravitational and magnetic conditions at ground level even if coarse gravitational maps of the Earth are available. It would also be possible to purposefully offset the timing of the clocks periodically in order to invalidate previously accepted offsets.

A remote clock would achieve the desired goal by emitting a neutrino-based ping which is received by a neutrino-based response system which listens only for these specialized signals. If the computational time needed to fetch the current time information on the side of the primary clock and transmit the signal could be established a priori, (as well as the time needed to interpret the signal at the site of the remote clock,) then the total latency time could be added to the received value in order to determine precisely the current time.

In addition to using the time-dilation-induced skew in the time of the remote clocks in order to authenticate signals, authentic transmissions could be dispatched at an agreed upon time which is extremely precise and this precision could form the basis of its own layer of security. Only an entity with the ability to broadcast a signal which begins at a femtosecond-precise time would have the capability of earmarking a transmission in this manner.

Conclusion

Given this aforementioned factors, it would make sense to deploy the portable neutrino detector mechanism described in 5 and 8 August 2025 in order to support a secure timecode communication mechanism linking two remote atomic clocks.